

This Page Is Inserted by IFW Operations
and is not a part of the Official Record

BEST AVAILABLE IMAGES

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images may include (but are not limited to):

- BLACK BORDERS
- TEXT CUT OFF AT TOP, BOTTOM OR SIDES
- FADED TEXT
- ILLEGIBLE TEXT
- SKEWED/SLANTED IMAGES
- COLORED PHOTOS
- BLACK OR VERY BLACK AND WHITE DARK PHOTOS
- GRAY SCALE DOCUMENTS

IMAGES ARE BEST AVAILABLE COPY.

**As rescanning documents *will not* correct images,
please do not report the images to the
Image Problems Mailbox.**

EUROPEAN PATENT OFFICE

Patent Abstracts of Japan

PUBLICATION NUMBER : 11277745
PUBLICATION DATE : 12-10-99

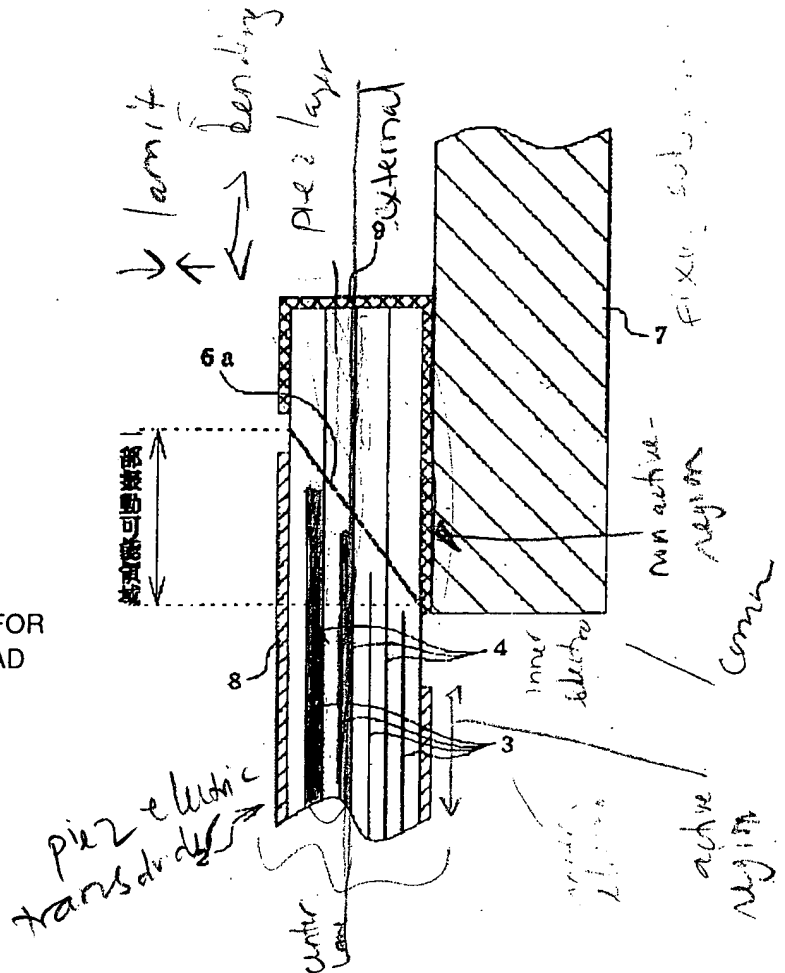
APPLICATION DATE : 30-03-98
APPLICATION NUMBER : 10102148

APPLICANT : SEIKO EPSON CORP;

INVENTOR : KITAHARA TSUTOMU;

INT.CL. : B41J 2/045 B41J 2/055 B41J 2/16

TITLE : PIEZOELECTRIC VIBRATOR UNIT FOR
DRIVING INK JET RECORDING HEAD
AND MANUFACTURE THEREOF

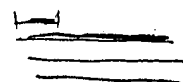


ABSTRACT : PROBLEM TO BE SOLVED: To effectively use a piezoelectric material by expanding a deformation region to a region of a fixing substrate.

SOLUTION: One end of a piezoelectric material plate constituted such that an inner electrode 3 as one electrode and an inner electrode 4 as the other electrode are laminated together with a piezoelectric material is fixed to a fixing substrate 7. The piezoelectric material plate is divided in a tooth shape by a slit having an end face 6a in an inclined face of which cut face at a surface side of the piezoelectric material plate is at a rear end side of a cut face at a side of the fixing substrate 7. A region opposed to the fixing substrate 7 is made to be a partial vibratable region.

COPYRIGHT: (C)1999,JPO

resistivity is diff between 2 layer
has diff thickness
resistivity



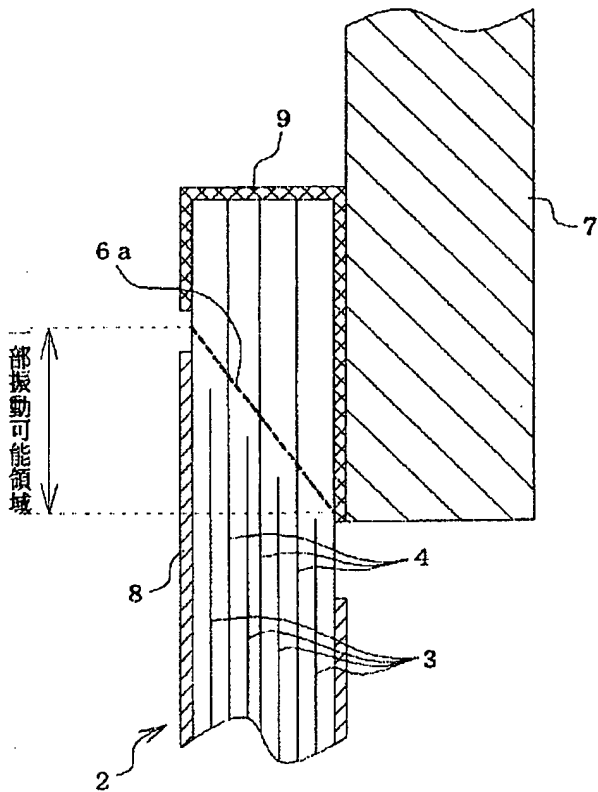
JAPANESE

[JP,11-277745,A]

CLAIMS DETAILED DESCRIPTION TECHNICAL FIELD PRIOR ART EFFECT OF THE INVENTION TECHNICAL
PROBLEM MEANS OPERATION DESCRIPTION OF DRAWINGS DRAWINGS

[Translation done.]

Drawing selection ▼



[Translation done.]

* NOTICES *

Japan Patent Office is not responsible for any damages caused by the use of this translation.

1. This document has been translated by computer. So the translation may not reflect the original precisely.
2. **** shows the word which can not be translated.
3. In the drawings, any words are not translated.

CLAIMS

[Claim(s)]

[Claim 1] The piezoelectric-material plate constituted by carrying out the laminating of the internal electrode which makes the internal electrode which makes one pole, and the pole of another side with piezoelectric material half the one is fixed to a fixed substrate -- from free one end of the aforementioned piezoelectric-material plate both The piezoelectric-transducer unit for an ink-jet formula record head drive which formed in the aforementioned piezoelectric-material plate the slit to which the cut end by the side of the front face of the aforementioned piezoelectric-material plate serves as the slant face which reaches a back end side from the cut end by the side of the aforementioned fixed substrate, and carried out the gear-tooth rate to the piezoelectric transducer.

[Claim 2] The piezoelectric-transducer unit for an ink-jet formula record head drive according to claim 1 in which the aforementioned slit is formed so that the edge field of the aforementioned fixed substrate of the aforementioned piezoelectric material may turn into a continuity field.

[Claim 3] The piezoelectric-transducer unit for an ink-jet formula record head drive according to claim 1 in which the end face of aforementioned one internal electrode is formed so that it may be equal to the aforementioned slant face.

[Claim 4] The piezoelectric-transducer unit for an ink-jet formula record head drive according to claim 1 in which the aforementioned internal electrode is formed in parallel with the displacement orientation of a piezoelectric transducer.

[Claim 5] The piezoelectric-transducer unit for an ink-jet formula record head drive according to claim 1 in which the back end side of the internal electrode exposed to the free end of the aforementioned piezoelectric-material plate is formed so that it may be equal to the aforementioned slant face.

[Claim 6] The piezoelectric-transducer unit for an ink-jet formula record head drive according to claim 1 to which the internal electrode exposed to the free end of the aforementioned piezoelectric-material plate has a spacing on the aforementioned slant face.

[Claim 7] The piezoelectric-transducer unit for an ink-jet formula record head drive according to claim 1 to which the aforementioned slit has reached the aforementioned substrate.

[Claim 8] The piezoelectric-transducer unit for an ink-jet formula record head drive according to claim 1 by which the reinforcement member is prepared in the end face by the side of the fixed substrate of the aforementioned piezoelectric transducer.

[Claim 9] The piezoelectric-transducer unit for an ink-jet formula record head drive according to claim 1 to which the internal electrode exposed to the front face of the aforementioned piezoelectric-material plate has a clearance on the aforementioned slant face.

[Claim 10] The piezoelectric-transducer unit for an ink-jet formula record head drive according to claim 4 by which the internal electrode exposed to the field of the aforementioned free end is connected to the segment electrode.

[Claim 11] The piezoelectric-transducer unit for an ink-jet formula record head drive according to claim 4 by which the back end section of all of the aforementioned internal electrodes is exposed to the back end side of the aforementioned piezoelectric transducer.

[Claim 12] The piezoelectric-transducer unit for an ink-jet formula record head drive according to claim 4 by which the internal electrode exposed to the aforementioned back end side is connected to the common electrode.

[Claim 13] The piezoelectric-transducer unit for an ink-jet formula record head drive according to claim 1 in which the aforementioned internal electrode is formed at right angles to the displacement orientation of the aforementioned piezoelectric transducer.

[Claim 14] The piezoelectric-transducer unit for an ink-jet formula record head drive according to claim 13 by which the internal electrode exposed to the aforementioned fixed substrate side is connected to the aforementioned common electrode.

[Claim 15] The piezoelectric-transducer unit for an ink-jet formula record head drive according to claim 13 by which the internal electrode which is located in free one end rather than the cut end by the side of the front face of the aforementioned piezoelectric-material plate, and is exposed to a front face is connected to the segment electrode.

[Claim 16] The piezoelectric-transducer unit for an ink-jet formula record head drive according to claim 13 in which the other end of the internal electrode exposed to the front face of the aforementioned piezoelectric-material plate is formed so that it may be equal to the aforementioned slant face.

[Claim 17] The piezoelectric-transducer unit for an ink-jet formula record head drive according to claim 13 in which the thickness

of the piezoelectric material by the side of the nose of cam of the aforementioned piezoelectric transducer is formed more greatly than the internal inter-electrode thickness of other fields.

[Claim 18] While half the one is fixed to a fixed substrate, the piezoelectric-material plate constituted by carrying out the laminating of the internal electrode which makes the internal electrode which makes one pole, and the pole of another side with piezoelectric material From free one end of the aforementioned piezoelectric-material plate, the cut end by the side of the front face of the aforementioned piezoelectric-material plate forms in the aforementioned piezoelectric-material plate the slit which serves as the slant face which reaches a back end side from the cut end by the side of the aforementioned fixed substrate, and carry out a gear-tooth rate to a piezoelectric transducer, and it is constituted. And the piezoelectric-transducer unit for an ink-jet formula record head drive to which the field which counters the aforementioned fixed substrate of free one end rather than the aforementioned cut end makes an active region.

[Claim 19] The internal electrode which makes the internal electrode which makes one pole, and the pole of another side vacates a fixed, predetermined spacing in the split start orientation of a piezoelectric-material plate, and carries out a lap by the active region. And the process which carries out a laminating and forms a laminated material with the green sheet of piezoelectric material so that each may be exposed at one edge, The process which calcinates the aforementioned laminated material and forms a piezoelectric-material plate, and the process which forms the external electrode which flows in each of the internal electrode of each aforementioned pole, the process which fixes to a fixed substrate the field in which the aforementioned external electrode is formed, and the process which carries out the gear-tooth rate of the field where the aforementioned internal electrode used as the activity section of the aforementioned piezoelectric-material plate carried out the lap mutually to the shape of a ctenidium -- since -- the becoming manufacture technique of the piezoelectric-transducer unit for an ink-jet formula record head drive

[Translation done.]

* NOTICES *

Japan Patent Office is not responsible for any damages caused by the use of this translation.

1. This document has been translated by computer. So the translation may not reflect the original precisely.
2. **** shows the word which can not be translated.
3. In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[The field of the technique in which invention belongs] this invention relates to the piezoelectric-transducer unit suitable for expanding and shrinking the pressure occurrence room of an ink-jet formula record head.

[0002]

[Description of the Prior Art] The ink-jet formula record head which used the piezoelectric transducer in the longitudinal-oscillation mode has a pressure occurrence room, an ink feed hopper, the passage formation substrate equipped with the reservoir, and two members with a piezoelectric-transducer unit, by each piezoelectric transducer which constitutes the piezoelectric-transducer unit, expands and shrinks a pressure occurrence room. the relation top which this piezoelectric-transducer unit fixes the end of a piezoelectric transducer to a fixed substrate, and arranges and constitutes a piezoelectric transducer from a fixed pitch, and a fixed area -- vibration -- the inactive field which presupposed un-forming an internal electrode so that a variation rate might not be produced is prepared

[0003]

[Problem(s) to be Solved by the Invention] However, since the inactive field which does not participate in vibration is also constituted in an expensive piezoelectric material, there is a problem cause elevation of a cost. Although the technique of joining with adhesives etc. a part for the fixed area constituted from a cheap material to the end of the piezoelectric transducer which constitutes only an oscillating field is also proposed in order to solve such a problem, a man day increases and there is a problem that a cost goes up. The place which this invention is made in view of such a problem, and is made into the purpose is offering the piezoelectric-transducer unit for an ink-jet formula record head drive which can raise displacement luminous efficacy and can carry out the deployment of the piezoelectric material, without comparing and needing a junction etc.

[0004] Other purposes of this invention are proposing the manufacture technique of the above-mentioned piezoelectric-transducer unit.

[0005]

[Means for Solving the Problem] In order to solve such a problem, it sets to this invention. The piezoelectric-material plate constituted by carrying out the laminating of the internal electrode which makes the internal electrode which makes one pole, and the pole of another side with piezoelectric material Both, from free one end of the aforementioned piezoelectric-material plate, the cut end by the side of the front face of the aforementioned piezoelectric-material plate forms in the aforementioned piezoelectric-material plate the slit which serves as the slant face for which half the one is fixed to a fixed substrate, and which reaches a back end side from the cut end by the side of the aforementioned fixed substrate, and was made to carry out a gear-tooth rate to a piezoelectric transducer.

[0006]

[Function] While the front-face side of the field which counters a fixed substrate is wide opened from a restraint and this field is made into the field which can vibrate, transmission of the variation rate by the side of a fixed substrate is prevented as much as possible, and a part of fixed area is used as a field which can be vibrated.

[0007]

[Embodiments of the Invention] Then, the example illustrated below is explained. It is the piezoelectric-transducer unit to which drawing 2 shows one example of a piezoelectric-transducer unit, and, as for the sign in drawing 1, this invention is again characterized by the record head for which drawing 1 used the piezoelectric-transducer unit of this invention. The laminating of the internal electrode 3 which makes a pole so that piezoelectric transducers 2 and 2 -- may be exposed only to a nose of cam and the back end, respectively, a lap may be carried out in the field used as an active region and while may form an inactive field by the substrate side further, and the internal electrode 4 which makes the pole of another side is carried out into piezoelectric material 5.

[0008] The internal electrode 3 which makes one pole is formed so that it may become parallel to end-face 6a of the slit which end-face 3a by the side of the passage unit 18 exposes to a nose of cam side, and other end 3b mentions later. The internal electrode 4 which makes the pole of another side is formed so that end-face 4a by the side of a passage unit may be buried in piezoelectric material 5 and the other end may be exposed to a back end side.

[0009] End-face 6a of a slit 6 is slanting so that the field side which counters the fixed substrate 7 may be made into the nose of cam side of a piezoelectric transducer 2 and the front-face side of a piezoelectric transducer 2 may be set to back end side 7a of

the fixed substrate 7, and it is formed in the field which counters the fixed substrate 7.

[0010] Thus, by forming a slit, there is no **** in presence of a slit 6 about the internal electrode 4 which makes the pole of another side, and switch-on can be formed among all the piezoelectric transducers 2, and it can leave the back end of a piezoelectric transducer as continuity section.

[0011] The common electrode 9 is formed of the vacuum evaporation and sputtering of an electrical conducting material from the field of free one end to [from the field which counters the fixed substrate 7 again] the field where the external electrode 8 counters a front-face side with the external electrode 8 via a back end side from the field again fixed to the fixed substrate 7 via an apical surface, and the piezoelectric transducer is connected to the flexible cable 10. In addition, the sign in drawing 11 shows the piezoelectric transducer of the dummy with the same structure as a piezoelectric transducer 2.

[0012] Through the fixed substrate 7, the head electrode holder 15 with which the pressure occurrence room 12, the ink feed hopper 13, and the above-mentioned passage unit 18 that forms a reservoir 14 were fixed is made to contact the elastic plate 16 which forms the passage unit 18, and the piezo-electric oscillating unit 1 fixes the nose of cam of a piezoelectric transducer 2 to it, and is included in the ink-jet formula record head. In addition, the sign in drawing 17 shows nozzle opening.

[0013] Thus, if supply of a driving signal is received through the flexible cable 10, it elongates and contracts to shaft orientations, and each piezoelectric transducer 2 of the constituted piezoelectric-transducer unit 1 will expand, and will shrink the pressure occurrence room 12. The ink of a reservoir 14 flows into the pressure occurrence room 12 via the ink feed hopper 13 by intumescence of the pressure occurrence room 12, and it is compressed after predetermined time, and is breathed out as an ink drop from the nozzle opening 17.

[0014] By the way, as shown in drawing 3, the amount of displacement to the same driver voltage size-comes to come, and the piezoelectric transducer 2 of this invention can pressurize the pressure occurrence room 12 effectively, since oscillating displacement is possible, although the field conventionally constituted as a non-vibrating field is at a partial target. Moreover, it is enabled to improve the regurgitation luminous efficacy of an ink drop, without there being no change in the natural-vibration frequency of piezoelectric-transducer 2 the very thing, and causing a mismatching among oscillation characteristics, such as a passage unit, since length L of free one end is fixed.

[0015] Next, the manufacture technique of a piezoelectric-transducer unit is explained based on the drawing 4 or the drawing 6. The green sheet 21 of the piezoelectric material which has a size for two or more sheets in the surface plate 20 with a flat front face, and was beforehand fabricated at class thickness is laid (drawing 4 (I)).

[0016] The layer 22 of an electrical conducting material is formed using the mask which while made the length L1 from near edge (inside [of drawing], upper limit) 21a to the end face of the fixed substrate 7 used as a free field width of face on the surface of this, and was equipped with the pattern of the internal electrode 3 (drawing 4 (II)), and the green sheet 21 of the piezoelectric material of the above-mentioned and the same size is put on the front face (drawing 4 (III)).

[0017] From edge 21a of edge (inside [of drawing], soffit) 21b to the free field used as a fixed area, the layer 23 of an electrical conducting material is formed using the mask equipped with the pattern of the internal electrode 4 so that distance L2 to the inside may be made into an agensis field a little (drawing 4 (IV)), and the green sheet 21 of piezoelectric material is put on the front face (drawing 5 (I)).

[0018] Layer 22' of the electrical conducting material widened even to the fixed-area side rather than the above-mentioned electric conduction layer 22 is formed, using as width of face the length L3 which is in agreement with the slant face of end-face 6a of a slit 6 from edge 21a of a free field (drawing 5 (II)), and the green sheet 21 of the piezoelectric material of the above-mentioned and the same size is put on the front face (drawing 5 (III)).

[0019] The same electric conduction layer 23' as the above-mentioned electric conduction layer 23 is formed from edge 21b of a fixed area so that the agensis field of some width of face L2 may be formed in free one end (drawing 5 (VI)).

[0020] the electric conduction patterns 22 and 22 which serve as the internal electrode 3 in this way [while] hereafter -- the predetermined number-of-layers laminating of 'the electric conduction layers 23 and 23 of -- which serve as the internal electrode of the pole of another side while expanding width of face to the edge 21b side of a fixed area gradually for every layer', and the green sheet 21 is carried out, and since a green sheet is dried, it calcinates

[0021] Thereby, since the piezo-electric diaphragm for two or more sheets is completed, after forming the external electrodes 24 and 25 used as the electrode for the connection with the flexible cable 10 in a front face by sputtering or vacuum evaporation, impressing a voltage to these electrodes 24 and 25 and performing predetermined polarization processing, it kicks by OFF to the piezo-electric diaphragm 26 of the size equivalent to a piezoelectric-transducer unit.

[0022] The electric conduction layer 22 and 22' through which positioned the piezoelectric-material plate 26 to the fixed substrate 27, and fixed with drawing 6 (I) adhesives (drawing 6 (II)), and it flowed by the external electrode 24 by the nose of cam side at least, To the position of the grade which can separate this external electrode layer 24 both, the slit 29 from which a soffit reaches angle 27a of the top by the side of the nose of cam of the fixed substrate 27 to the field where an upper-limit side counters the fixed substrate 27, and a termination side turns into a slant face is formed by the disconnection meanses 28, such as a nose of cam to a wire saw, and a gear-tooth rate is carried out.

[0023] Thus, electric resistance can use the external electrode 25 for a selection electrode for the external electrode 24 as a small common electrode as much as possible again by forming a slit 29 in the status that separated the external electrode layer 24 of free one end, and the external electrode 25 of a fixed area was made to continue.

[0024] In addition, in an above-mentioned example, although back end 3b of the electrode 3 exposed to a nose of cam side is doubled and formed in the slant face of end-face 6a of a slit, you may form electrode 3' which vacates spacing deltag more fixed

than the slant face of end-face 6a of a slit to a nose of cam side as shown in drawing 7, is located in the same field, and is exposed to the edge of a fixed area.

[0025] According to this example, since internal electrode 3' of a dummy is arranged also at the fixed area of a piezoelectric transducer 2, it becomes the almost same laminated structure as an oscillating field and the whole equalizes, curvature can be suppressed also to the big temperature change before and behind baking.

[0026] The laminating of the internal electrode 30 which makes a pole so that drawing 8 shows other examples of this invention, piezoelectric transducers 2 and 2 and 2 -- may be exposed only to the side face which is one side, respectively, and the side face of another side, a lap may be carried out in the field used as an active region and while may form an inactive field by the substrate side further, and the internal electrode 31 which makes the pole of another side is carried out into piezoelectric material 5.

[0027] Internal electrode 30' which an end exposes to the field of an opposite side the internal electrode 30 which makes one pole with the side which counters the fixed substrate 7, and the other end is buried in piezoelectric material 5, and is arranged to the field of the fixed substrate 7 is shorter formed by the fixed-end side so that end-face 30'a by the side of the fixed substrate 7 may be in agreement with slant-face 6a of the end face of a slit 6. Moreover, in the pole of another side, an end exposes the internal electrode 31 to the field by the side of the fixed substrate 7, and the other end is buried in piezoelectric material 5.

[0028] The internal electrode 31 is again connected to the flexible cable 10 by the common electrode 33 formed on the side face of a piezoelectric transducer at the segment electrode 32 by which the internal electrode 30 was formed in the side face of a piezoelectric transducer.

[0029] Also in this example, internal electrode 30' of a fixed area contributes to making piezoelectric material 5 produce piezoelectricity effect, and increasing the amount of displacement of the whole piezoelectric transducer with the internal electrode 31 of another side.

[0030] In addition, although it forms so that the end face of internal electrode 30' may be made in agreement with slant-face 6a of a slit 6 in an above-mentioned example, as shown in drawing 9 (b), fixed spacing deltag may be vacated to slant-face 6a, and internal electrode 30" of a dummy may be formed even to the field by the side of a fixed substrate on the same field.

[0031] According to this example, since the internal electrode of a piezoelectric transducer is arranged almost uniformly, the whole coefficient of thermal expansion can be equalized and the curvature by the temperature change etc. can be prevented.

[0032] In addition, if the salient 34 which contacts the back end side of a piezoelectric transducer is formed as shown in drawing 9 (b) although the fixed substrate 7 is made to support only the side face of the non-vibrating field of a piezoelectric transducer in an above-mentioned example, a positive bearing value can be obtained.

[0033] Even when thickness d of the piezoelectric material 5 to the nose of cam and electrode of free one end was furthermore made larger than the thickness of an electrode formation field, the apical surface which is comparatively easy to be missing is missing and 35 arises, an internal electrode can be made still buried in piezoelectric material 5, and the shunt by the external electrodes 32 and 33 can be prevented.

[0034]

[Effect of the Invention] As explained above, in this invention, the piezoelectric-material plate constituted by carrying out the laminating of the internal electrode which makes the internal electrode which makes one pole, and the pole of another side with piezoelectric material half the one is fixed to a fixed substrate -- from free one end of the aforementioned piezoelectric-material plate both Since the cut end by the side of the front face of a piezoelectric-material plate formed in the piezoelectric-material plate the slit which serves as the slant face which reaches a back end side from the cut end by the side of the aforementioned fixed substrate and carried out the gear-tooth rate to the piezoelectric transducer Transmission of the variation rate by the side of a fixed substrate can be prevented as much as possible, the opposite field with a fixed substrate can be wide opened from a restraint of a fixed substrate, and the amount of displacement of the whole piezoelectric transducer can be increased as displacement being possible.

[Translation done.]

*** NOTICES ***

**Japan Patent Office is not responsible for any
damages caused by the use of this translation.**

1. This document has been translated by computer. So the translation may not reflect the original precisely.
2. **** shows the word which can not be translated.
3. In the drawings, any words are not translated.

TECHNICAL FIELD

[The field of the technique in which invention belongs] this invention relates to the piezoelectric-transducer unit suitable for expanding and shrinking the pressure occurrence room of an ink-jet formula record head.

[Translation done.]

*** NOTICES ***

Japan Patent Office is not responsible for any damages caused by the use of this translation.

1. This document has been translated by computer. So the translation may not reflect the original precisely.
2. **** shows the word which can not be translated.
3. In the drawings, any words are not translated.

PRIOR ART

[Description of the Prior Art] The ink-jet formula record head which used the piezoelectric transducer in the longitudinal-oscillation mode has a pressure occurrence room, an ink feed hopper, the passage formation substrate equipped with the reservoir, and two members with a piezoelectric-transducer unit, by each piezoelectric transducer which constitutes the piezoelectric-transducer unit, expands and shrinks a pressure occurrence room. the relation top which this piezoelectric-transducer unit fixes the end of a piezoelectric transducer to a fixed substrate, and arranges and constitutes a piezoelectric transducer from a fixed pitch, and a fixed area -- vibration -- the inactive field which presupposed un-forming an internal electrode so that a variation rate might not be produced is prepared

[Translation done.]

*** NOTICES ***

Japan Patent Office is not responsible for any damages caused by the use of this translation.

1. This document has been translated by computer. So the translation may not reflect the original precisely.
2. **** shows the word which can not be translated.
3. In the drawings, any words are not translated.

EFFECT OF THE INVENTION

[Effect of the Invention] As explained above, in this invention, the piezoelectric-material plate constituted by carrying out the laminating of the internal electrode which makes the internal electrode which makes one pole, and the pole of another side with piezoelectric material half the one is fixed to a fixed substrate -- from free one end of the aforementioned piezoelectric-material plate both Since the cut end by the side of the front face of a piezoelectric-material plate formed in the piezoelectric-material plate the slit which serves as the slant face which reaches a back end side from the cut end by the side of the aforementioned fixed substrate and carried out the gear-tooth rate to the piezoelectric transducer Transmission of the variation rate by the side of a fixed substrate can be prevented as much as possible, the opposite field with a fixed substrate can be wide opened from a restraint of a fixed substrate, and the amount of displacement of the whole piezoelectric transducer can be increased as displacement being possible.

[Translation done.]

*** NOTICES ***

Japan Patent Office is not responsible for any damages caused by the use of this translation.

1. This document has been translated by computer. So the translation may not reflect the original precisely.
2. **** shows the word which can not be translated.
3. In the drawings, any words are not translated.

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] However, since the inactive field which does not participate in vibration is also constituted in an expensive piezoelectric material, there is a problem cause elevation of a cost. Although the technique of joining with adhesives etc. a part for the fixed area constituted from a cheap material to the end of the piezoelectric transducer which constitutes only an oscillating field is also proposed in order to solve such a problem, a man day increases and there is a problem that a cost goes up. The place which this invention is made in view of such a problem, and is made into the purpose is offering the piezoelectric-transducer unit for an ink-jet formula record head drive which can raise displacement luminous efficacy and can carry out the deployment of the piezoelectric material, without comparing and needing a junction etc.

[0004] Other purposes of this invention are proposing the manufacture technique of the above-mentioned piezoelectric-transducer unit.

[Translation done.]

*** NOTICES ***

**Japan Patent Office is not responsible for any
damages caused by the use of this translation.**

1. This document has been translated by computer. So the translation may not reflect the original precisely.
2. **** shows the word which can not be translated.
3. In the drawings, any words are not translated.

MEANS

[Means for Solving the Problem] In order to solve such a problem, it sets to this invention. The piezoelectric-material plate constituted by carrying out the laminating of the internal electrode which makes the internal electrode which makes one pole, and the pole of another side with piezoelectric material Both, from free one end of the aforementioned piezoelectric-material plate, the cut end by the side of the front face of the aforementioned piezoelectric-material plate forms in the aforementioned piezoelectric-material plate the slit which serves as the slant face for which half the one is fixed to a fixed substrate, and which reaches a back end side from the cut end by the side of the aforementioned fixed substrate, and was made to carry out a gear-tooth rate to a piezoelectric transducer.

[Translation done.]

*** NOTICES ***

Japan Patent Office is not responsible for any damages caused by the use of this translation.

1. This document has been translated by computer. So the translation may not reflect the original precisely.
2. **** shows the word which can not be translated.
3. In the drawings, any words are not translated.

OPERATION

[Function] While the front-face side of the field which counters a fixed substrate is wide opened from a restraint and this field is made into the field which can vibrate, transmission of the variation rate by the side of a fixed substrate is prevented as much as possible, and a part of fixed area is used as a field which can be vibrated.

[0007]

[Embodiments of the Invention] Then, the example illustrated below is explained. It is the piezoelectric-transducer unit to which drawing 2 shows one example of a piezoelectric-transducer unit, and, as for the sign in drawing 1, this invention is again characterized by the record head for which drawing 1 used the piezoelectric-transducer unit of this invention. The laminating of the internal electrode 3 which makes a pole so that piezoelectric transducers 2 and 2 and 2 -- may be exposed only to a nose of cam and the back end, respectively, a lap may be carried out in the field used as an active region and while may form an inactive field by the substrate side further, and the internal electrode 4 which makes the pole of another side is carried out into piezoelectric material 5.

[0008] The internal electrode 3 which makes one pole is formed so that it may become parallel to end-face 6a of the slit which end-face 3a by the side of the passage unit 18 exposes to a nose of cam side, and other end 3b mentions later. The internal electrode 4 which makes the pole of another side is formed so that end-face 4a by the side of a passage unit may be buried in piezoelectric material 5 and the other end may be exposed to a back end side.

[0009] End-face 6a of a slit 6 is slanting so that the field side which counters the fixed substrate 7 may be made into the nose of cam side of a piezoelectric transducer 2 and the front-face side of a piezoelectric transducer 2 may be set to back end side 7a of the fixed substrate 7, and it is formed in the field which counters the fixed substrate 7.

[0010] Thus, by forming a slit, there is no **** in presence of a slit 6 about the internal electrode 4 which makes the pole of another side, and switch-on can be formed among all the piezoelectric transducers 2, and it can leave the back end of a piezoelectric transducer as continuity section.

[0011] The common electrode 9 is formed of the vacuum evaporation and sputtering of an electrical conducting material from the field of free one end to [from the field which counters the fixed substrate 7 again] the field where the external electrode 8 counters a front-face side with the external electrode 8 via a back end side from the field again fixed to the fixed substrate 7 via an apical surface, and the piezoelectric transducer is connected to the flexible cable 10. In addition, the sign in drawing 11 shows the piezoelectric transducer of the dummy with the same structure as a piezoelectric transducer 2.

[0012] Through the fixed substrate 7, the head electrode holder 15 with which the pressure occurrence room 12, the ink feed hopper 13, and the above-mentioned passage unit 18 that forms a reservoir 14 were fixed is made to contact the elastic plate 16 which forms the passage unit 18, and the piezo-electric oscillating unit 1 fixes the nose of cam of a piezoelectric transducer 2 to it, and is included in the ink-jet formula record head. In addition, the sign in drawing 17 shows nozzle opening.

[0013] Thus, if supply of a driving signal is received through the flexible cable 10, it elongates and contracts to shaft orientations, and each piezoelectric transducer 2 of the constituted piezoelectric-transducer unit 1 will expand, and will shrink the pressure occurrence room 12. The ink of a reservoir 14 flows into the pressure occurrence room 12 via the ink feed hopper 13 by intumescence of the pressure occurrence room 12, and it is compressed after predetermined time, and is breathed out as an ink drop from the nozzle opening 17.

[0014] By the way, as shown in drawing 3, the amount of displacement to the same driver voltage size-comes to come, and the piezoelectric transducer 2 of this invention can pressurize the pressure occurrence room 12 effectively, since oscillating displacement is possible, although the field conventionally constituted as a non-vibrating field is at a partial target. Moreover, it is enabled to improve the regurgitation luminous efficacy of an ink drop, without there being no change in the natural-vibration frequency of piezoelectric-transducer 2 the very thing, and causing a mismatching among oscillation characteristics, such as a passage unit, since length L of free one end is fixed.

[0015] Next, the manufacture technique of a piezoelectric-transducer unit is explained based on the drawing 4 or the drawing 6. The green sheet 21 of the piezoelectric material which has a size for two or more sheets in the surface plate 20 with a flat front face, and was beforehand fabricated at class thickness is laid (drawing 4 (I)).

[0016] The layer 22 of an electrical conducting material is formed using the mask which while made the length L1 from near edge (inside [of drawing], upper limit) 21a to the end face of the fixed substrate 7 used as a free field width of face on the surface of this, and was equipped with the pattern of the internal electrode 3 (drawing 4 (II)), and the green sheet 21 of the piezoelectric material of the above-mentioned and the same size is put on the front face (drawing 4 (III)).

[0017] From edge 21a of edge (inside [of drawing], soffit) 21b to the free field used as a fixed area, the layer 23 of an electrical conducting material is formed using the mask equipped with the pattern of the internal electrode 4 so that distance L2 to the inside may be made into an agensis field a little (drawing 4 (IV)), and the green sheet 21 of piezoelectric material is put on the front face (drawing 5 (I)).

[0018] Layer 22' of the electrical conducting material widened even to the fixed-area side rather than the above-mentioned electric conduction layer 22 is formed, using as width of face the length L3 which is in agreement with the slant face of end-face 6a of a slit 6 from edge 21a of a free field (drawing 5 (II)), and the green sheet 21 of the piezoelectric material of the above-mentioned and the same size is put on the front face (drawing 5 (III)).

[0019] The same electric conduction layer 23' as the above-mentioned electric conduction layer 23 is formed from edge 21b of a fixed area so that the agensis field of some width of face L2 may be formed in free one end (drawing 5 (VI)).

[0020] the electric conduction patterns 22 and 22 which serve as the internal electrode 3 in this way [while] hereafter -- the predetermined number-of-layers laminating of 'the electric conduction layers 23 and 23 of -- which serve as the internal electrode of the pole of another side while expanding width of face to the edge 21b side of a fixed area gradually for every layer', and the green sheet 21 is carried out, and since a green sheet is dried, it calcinates

[0021] Thereby, since the piezo-electric diaphragm for two or more sheets is completed, after forming the external electrodes 24 and 25 used as the electrode for the connection with the flexible cable 10 in a front face by sputtering or vacuum evaporation, impressing a voltage to these electrodes 24 and 25 and performing predetermined polarization processing, it kicks by OFF to the piezo-electric diaphragm 26 of the size equivalent to a piezoelectric-transducer unit.

[0022] The electric conduction layer 22 and 22' through which positioned the piezoelectric-material plate 26 to the fixed substrate 27, and fixed with drawing 6 (I) adhesives (drawing 6 (II)), and it flowed by the external electrode 24 by the nose of cam side at least, To the position of the grade which can separate this external electrode layer 24 both, the slit 29 from which a soffit reaches angle 27a of the top by the side of the nose of cam of the fixed substrate 27 to the field where a upper-limit side counters the fixed substrate 27, and a termination side turns into a slant face is formed by the disconnection meanses 28, such as a nose of cam to a wire saw, and a gear-tooth rate is carried out.

[0023] Thus, electric resistance can use the external electrode 25 for a selection electrode for the external electrode 24 as a small common electrode as much as possible again by forming a slit 29 in the status that separated the external electrode layer 24 of free one end, and the external electrode 25 of a fixed area was made to continue.

[0024] In addition, in an above-mentioned example, although back end 3b of the electrode 3 exposed to a nose of cam side is doubled and formed in the slant face of end-face 6a of a slit, you may form electrode 3' which vacates spacing deltag more fixed than the slant face of end-face 6a of a slit to a nose of cam side as shown in drawing 7 , is located in the same field, and is exposed to the edge of a fixed area.

[0025] According to this example, since internal electrode 3' of a dummy is arranged also at the fixed area of a piezoelectric transducer 2, it becomes the almost same laminated structure as an oscillating field and the whole equalizes, curvature can be suppressed also to the big temperature change before and behind baking.

[0026] The laminating of the internal electrode 30 which makes a pole so that drawing 8 shows other examples of this invention, piezoelectric transducers 2 and 2 and 2 -- may be exposed only to the side face which is one side, respectively, and the side face of another side, a lap may be carried out in the field used as an active region and while may form an inactive field by the substrate side further, and the internal electrode 31 which makes the pole of another side is carried out into piezoelectric material 5.

[0027] Internal electrode 30' which an end exposes to the field of an opposite side the internal electrode 30 which makes one pole with the side which counters the fixed substrate 7, and the other end is buried in piezoelectric material 5, and is arranged to the field of the fixed substrate 7 is shorter formed by the fixed-end side so that end-face 30'a by the side of the fixed substrate 7 may be in agreement with slant-face 6a of the end face of a slit 6. Moreover, in the pole of another side, an end exposes the internal electrode 31 to the field by the side of the fixed substrate 7, and the other end is buried in piezoelectric material 5.

[0028] The internal electrode 31 is again connected to the flexible cable 10 by the common electrode 33 formed on the side face of a piezoelectric transducer at the segment electrode 32 by which the internal electrode 30 was formed in the side face of a piezoelectric transducer.

[0029] Also in this example, internal electrode 30' of a fixed area contributes to making piezoelectric material 5 produce piezoelectricity effect, and increasing the amount of displacement of the whole piezoelectric transducer with the internal electrode 31 of another side.

[0030] In addition, although it forms so that the end face of internal electrode 30' may be made in agreement with slant-face 6a of a slit 6 in an above-mentioned example, as shown in drawing 9 (b), fixed spacing deltag may be vacated to slant-face 6a, and internal electrode 30' of a dummy may be formed even to the field by the side of a fixed substrate on the same field.

[0031] According to this example, since the internal electrode of a piezoelectric transducer is arranged almost uniformly, the whole coefficient of thermal expansion can be equalized and the curvature by the temperature change etc. can be prevented.

[0032] In addition, if the salient 34 which contacts the back end side of a piezoelectric transducer is formed as shown in drawing 9 (b) although the fixed substrate 7 is made to support only the side face of the non-vibrating field of a piezoelectric transducer in an above-mentioned example, a positive bearing value can be obtained.

[0033] Even when thickness d of the piezoelectric material 5 to the nose of cam and electrode of free one end was furthermore made larger than the thickness of an electrode formation field, the apical surface which is comparatively easy to be missing is missing and 35 arises, an internal electrode can be made still buried in piezoelectric material 5, and the shunt by the external

electrodes 32 and 33 can be prevented.

[Translation done.]

*** NOTICES ***

Japan Patent Office is not responsible for any damages caused by the use of this translation.

1. This document has been translated by computer. So the translation may not reflect the original precisely.
2. **** shows the word which can not be translated.
3. In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is the cross section showing one example of the ink-jet formula record head which used the piezoelectric-transducer unit of this invention.

[Drawing 2] Drawing (b) and (b) are the perspective diagrams showing the structure of the front reverse of one example of a piezoelectric-transducer unit same as the above, respectively.

[Drawing 3] It is explanatory drawing showing the active region of a piezoelectric transducer same as the above.

[Drawing 4] Drawing (I) or (IV) is drawing showing the laminating process of piezoelectric material and an electrical conducting material among the manufacturing processes of the piezoelectric-transducer unit of this invention, respectively.

[Drawing 5] Drawing (I) or (IV) is drawing showing the laminating process of piezoelectric material and an electrical conducting material among the manufacturing processes of the piezoelectric-transducer unit of this invention, respectively.

[Drawing 6] They are drawing (I) or (III) drawing showing the process of a gear-tooth rate among the manufacturing processes of the piezoelectric-transducer unit of this invention, respectively.

[Drawing 7] It is the cross section showing other examples of this invention.

[Drawing 8] It is the cross section showing one example of the ink-jet formula record head which used the piezoelectric-transducer unit of this invention.

[Drawing 9] Drawing (b) and (b) are the cross sections showing other examples of this invention, respectively.

[Description of Notations]

1 Piezo-electric Oscillating Unit

2 Piezoelectric Transducer

3, 4 Internal electrode

5 Piezoelectric Material

6 Slit

6a The end face of a slit

7 Fixed Substrate

8 Segment Electrode

9 Common Electrode

10 ***** Cable

11 Passage Unit

[Translation done.]

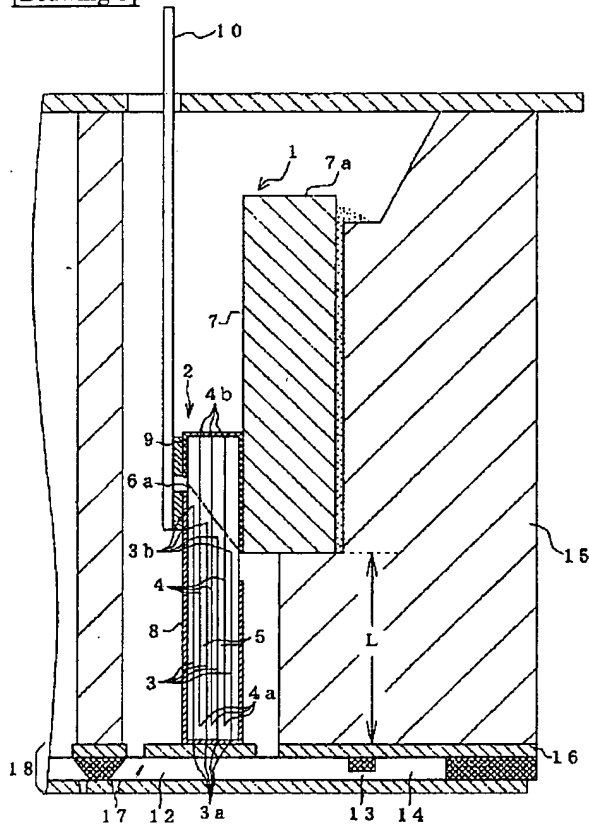
* NOTICES *

Japan Patent Office is not responsible for any damages caused by the use of this translation.

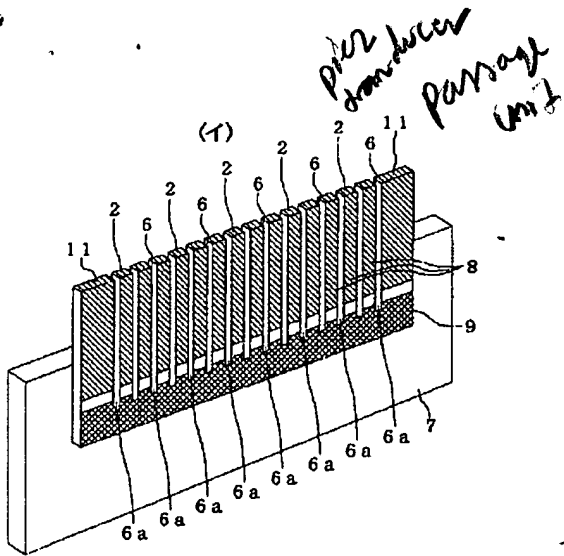
1. This document has been translated by computer. So the translation may not reflect the original precisely.
2. **** shows the word which can not be translated.
3. In the drawings, any words are not translated.

DRAWINGS

[Drawing 1]

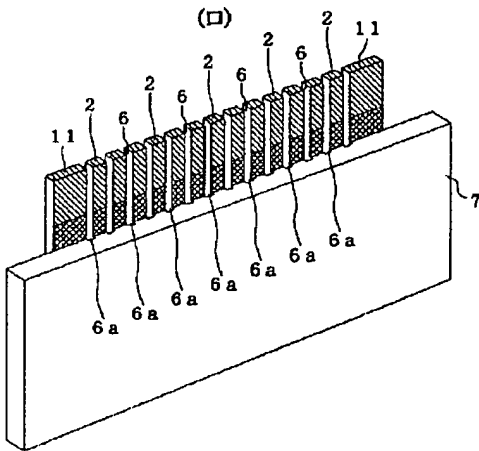


[Drawing 2]

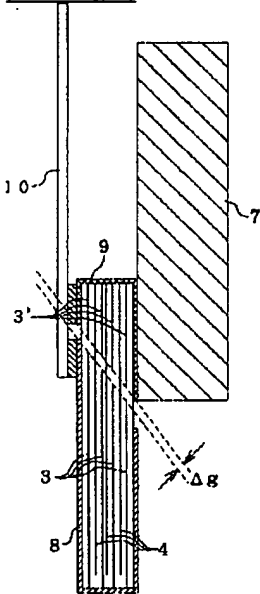


Comb

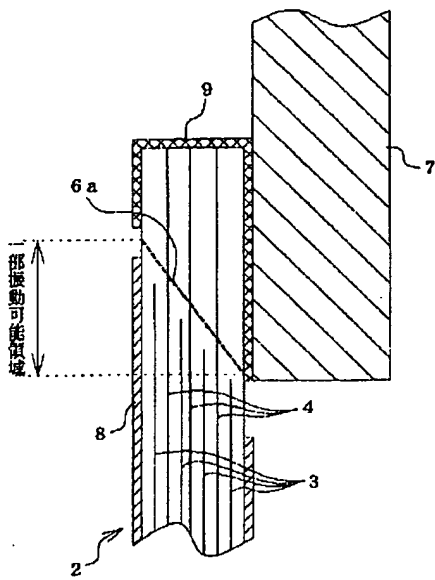
2



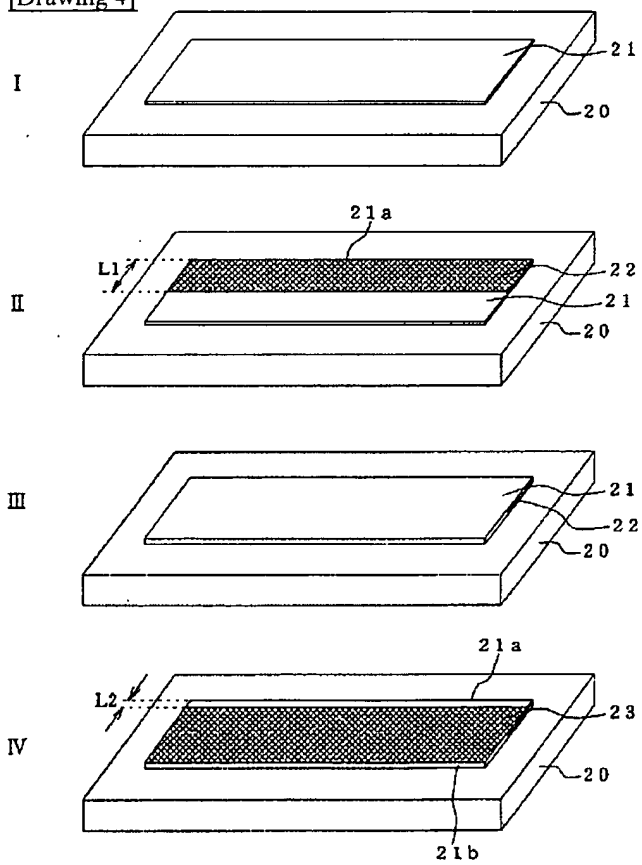
[Drawing 7]



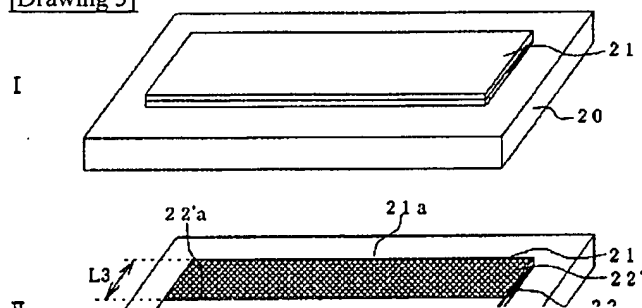
[Drawing 3]



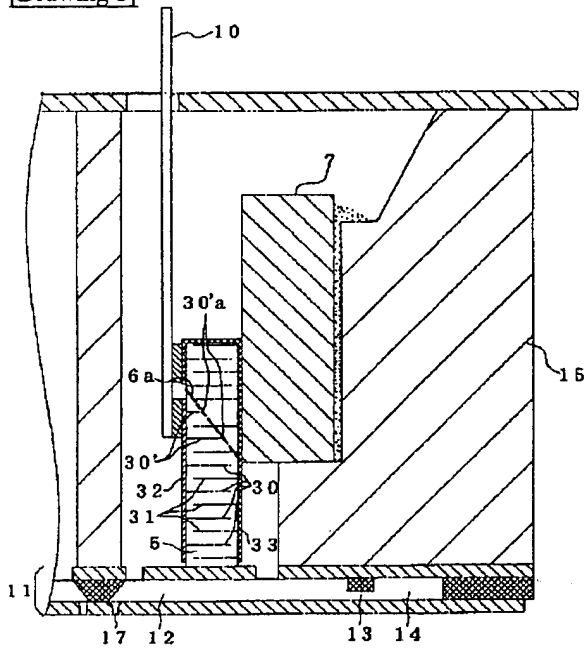
[Drawing 4]



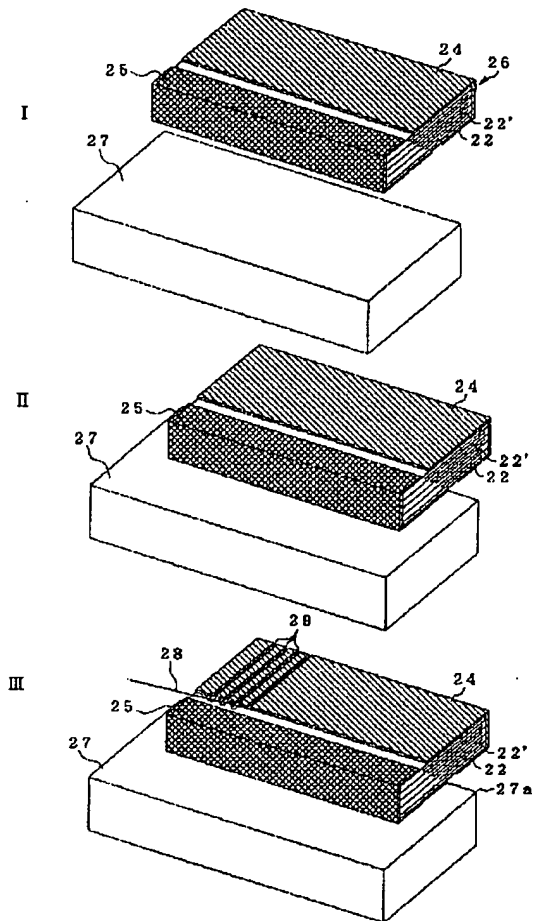
[Drawing 5]



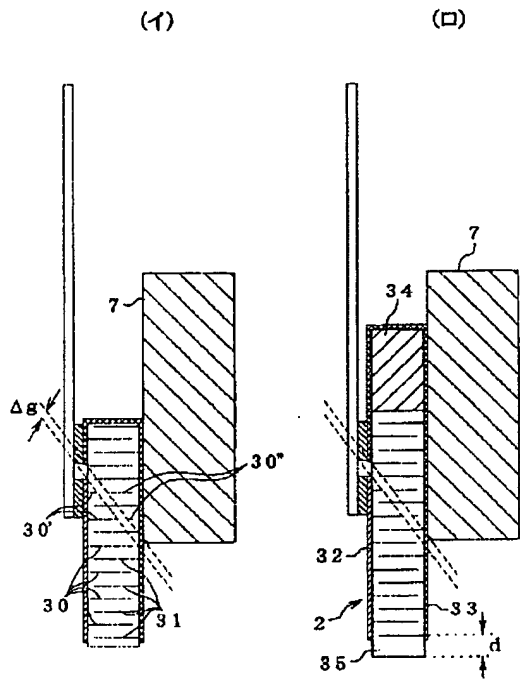
[Drawing 8]



[Drawing 6]



[Drawing 9]



[Translation done.]